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Dietary patterns in adult patients with Non-Alcoholic Fatty Liver Disease in Iraq

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ABSTRACT

Objectives: The aim of this study was to assess the dietary patterns of Iraqi patients with non- alcoholic fatty liver disease (NAFLD) and compare it with controls. *Subjects and methods*: A case control study, that included 88 Iraqi patients, aged between 18 and 70 years, of the 88 patients, 46 Iraqi patients were having NAFLD (identified as cases), and 42 patients were free of liver disease and they were considered as controls. The assessment of the dietary intake during the last 6 months was done through utilizing Food frequency questionnaire. NAFLD was diagnosed by using ultrasonography showing specific changes of that disease together with no excessive drinking of alcoholic beverages. *Results:* There were statistically significant higher rates of daily consumption of processed meats (p-value 0.03), pasta (p-value 0.010) and soft drinks (p-value 0.023) regarding daily portion of most western food items in comparison between patients with NAFLD and control group. And there were statistically significant higher rates of daily consumption of corn oil (p-value 0.027) and soft drinks (p-value 0.023) in the traditional Iraqi food items in comparison between patients with NAFLD and control group. Regarding body weight (p-value 0.003), BMI (p-value 0.033) and waist circumference (p-value <0.001), they were significantly higher among cases with NAFLD. *Conclusion*: The current study has found that the western diet patterns in particular processed meat, pasta and soft drinks were associated with a higher risk for NAFLD in Iraqi adults.

Keywords: NAFLD, dietary pattern, body weight, liver disease

1. INTRODUCTION

Nonalcoholic fatty liver disease is the most frequent form of chronic liver disease around the world, as it affects 15% to 35% of the global population (Orci et al., 2016). World-widely the prevalence of NAFLD was increasing, along with that of obesity, in the last decades (Bedogni et al., 2014, Younossi et al., 2016). Rates of NAFLD are high, as it reaches to 90% in obese people and 50% in diabetics (Bellentani, 2017; Zoppini et al., 2014). NAFLD is referred to as the accumulation of lipids, especially triglycerides, in hepatocytes of peoples who do not consume large amounts of alcohol (≤2 drinks/day for women, ≤3 drinks/day for men) (Marchesini et al., 1999), without other known

causes of steatosis, such as certain chronic liver diseases (hepatitis A, B, and C, Wilson's disease) or medications, NAFLD is related to the clinical features of metabolic syndrome especially type 2 diabetes and dyslipidemia (Marchesini et al., 2001; Thomas et al. 2020; Sayadishahraki et al. 2020).

The pathogenesis of NAFLD is unknown; however, obesity and insulin resistance are thought to influence the development of the disease (Cordero et al., 2019). It encompasses a number of liver changes, from simple steatosis to non-alcoholic steatohepatitis (NASH), that can progress to cirrhosis and hepatocellular carcinoma (Smith and Adams, 2011). It has been anticipated that NAFLD is becoming the principle risk factor for hepatocellular carcinoma, the most common form of liver cancer (Schulz et al., 2015), and NASH cirrhosis has come to be a common cause for the need of liver transplantation (Vernon et al., 2011). In the previous decades, food has been taken into consideration as a critical pathogenic factor of NAFLD; there are numerous researches that show an association between diet and NAFLD risk (Adriano et al., 2016). A nutritional sample evaluation enables the assessment of the results of diet by quantification of the cumulative impact of multiple nutrients (Tucker, 2010).

In the present time, fast economic growth, globalization, and urbanization are all causing a dramatic shift in the conventional nutritional patterns to Western patterns (Ganguli et al., 2011). Efficacy and safety profiles of pharmacotherapies aimed towards treating NAFLD are lacking; as a consequence, life-style interventions, consisting of nutritional adjustments and increased physical activity, are the mainstay treatments (Cheung and Sanyal, 2010). A decrease in body weight of 3–5% can ameliorate hepatic steatosis, however, a greater weight loss (5–10% body weight) is wanted to reduce hepatic inflammation (Marchesini et al., 2016).

Aim of the study

To evaluate the dietary patterns as risk factors for NAFLD

2. SUBJECTS AND METHODS

Study population

This is a case control study targeting Iraqi patients with NAFLD attending the outpatient clinic of the Gastroenterology and Hepatology Teaching Hospitalin the medical city/ Baghdad, carried out from January 2021 until March 2021. The study participants were interviewed by the researcher with questionnaire. The total number enrolled in the study was 88 Iraqi patients, aged between 18 and 70 years, of the 88 patients, 46 Iraqis patients were having NAFLD (identified as cases), and 42 patients were free of liver disease and they were considered as controls.

The exclusion criteria were (1) diabetes mellitus (2) use of steatogenic medications within the last 6 months: aspirin, NSAID, glucocorticoids, amiodarone, methotrexate, valproate, tamoxifin. (3) Chronic liver disease (4) chronic hepatitis infection (5) previous bariatric surgery (6) pregnant or lactating women (7) alcohol intake.

In the study cases were excluded, as 8 of them were diabetics, 3 cases were on non-steroidal anti-inflammatory drugs (NSAID) for longer than 3 months, 2 cases with chronic Hepatitis C disease, 1 case on glucocorticoid treatment for years, another 1 had bariatric surgery and 1 case was drinking alcohol, as illustrated in Figure (1).

Demographic and life style data

Demographic data such as age, gender, occupation, education, and residency were recorded, also included questions regarding smoking and alcohol consumption. The patient was regarded as a current smoker if he smokes ≥1 cigarettes/day, 1 cigar/day, or 1 water pipe/week. While for alcohol consumption (>20 g/d for men and >10 g/d for women) is considered significant.

Assessment of dietary intake

Obtained using a questionnaire which is a food frequency questionnaire (FFQ), which is used to measure long term dietary intake, but the portion sizes are often poorly estimated. The FFQ included 23 food groups that were adapted to Iraqi diet, these food groups included: Rice, grains, pasta, legumes, fruits, vegetables, eggs, dairy products, red meat, chicken, fish, mushroom, processed meats, pickles, cakes and snacks, nuts, seeds, fat/oils, fast foods, soft drinks, tea, coffee and sugar.

Grains were divided into twoseparate-groups: refined grains and whole grains, A whole grain if it contains the three parts of seed: the bran, germs, and endosperms, this includes: whole wheat flour and bread, oats, brown rice and bulgur. Refined grains involve removal of bran and germ like: white flour, white rice and white bread. Legumes include: beans, peas, chickpeas and lentils. Dairy products include: milk, yogurt and cheese. Processed meats include: sausages, salami, mortadella and canned meat. The snack group comprises: chocolates, popcorn, gypsum and backed goods. Fat/oils include: olive oil, corn oil, sunflower oil, canola

oil, palm oil and butter. The Fast foods include foods bought from the restaurants like hamburgers, pizza, Kentucky fried chicken, French fries and others, while the sugars include: table sugar, honey and molasses.

The Participants were asked to estimate their typical intake frequency of various foods within the last 6 months before the data collection by selecting one of the four choices: never, daily, weekly, and monthly.

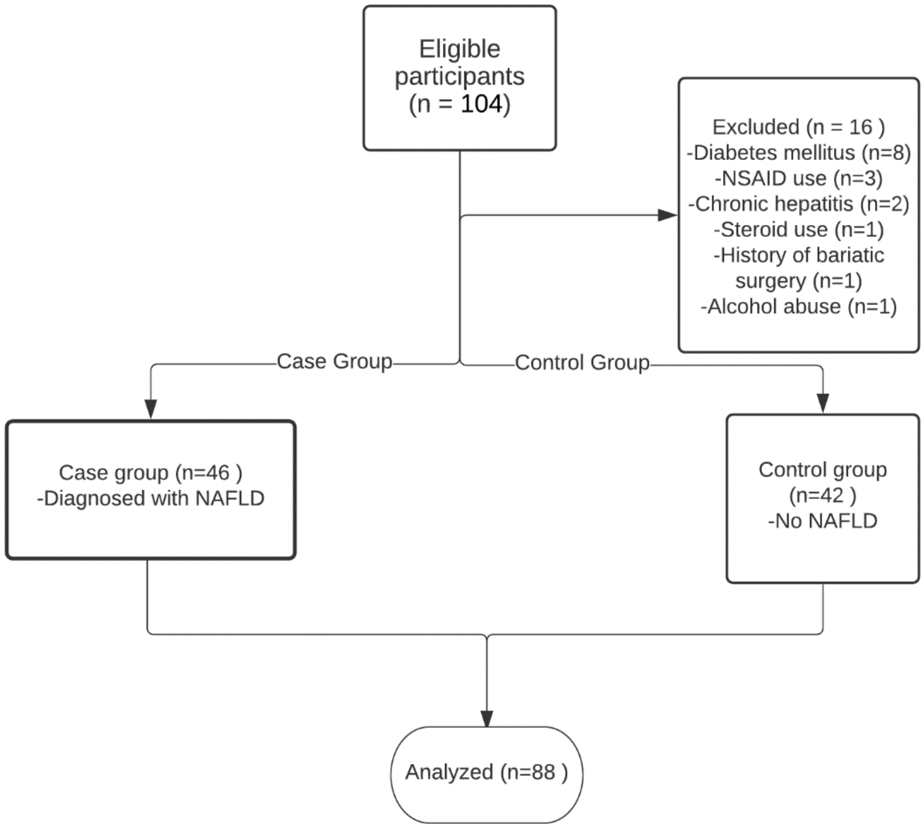

Figure 1 Flowchart for study participants

Clinical and laboratory assessments

Anthropometric measures included Body height and weight, Body mass index (BMI), and Waist circumference (WC). Patients were classified according to the World Health Organization (WHO) obesity classification. The waist circumference are cut-off values >88 cm for women, >102 cm for men. All the patients studied were either overweight or obese except for one patient with normal BMI. Information about the physical activity: including the level of physical activity at work, transportation, exercise and household activities was collected. Diabetes mellitus was identified as a serum fasting glucose level ≥126 mg/dL or by using antidiabetic medications, yet all patients with diabetes mellitus were excluded.

The laboratory tests involved the serum levels of: fasting glucose, total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), uric acid, alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), antibody to hepatitis C virus, and hepatitis B surface antigen were performed using standard laboratory methods. NAFLD was diagnosed by using ultrasonography examination that is done a single radiologist and classified, absent, mild, moderate, and severe NAFLD according to the appearance of intrahepatic vasculature, liver connective tissue and diaphragm (Ferraioli and Soares Monteiro, 2019).

Statistical analysis

Data tabulation, input and handling was done using IBM SPSS version 22. Comparison between categorical variables was done using Chi-Square test. Normal distribution of variables was examined by Anderson-Darling Test, and comparison between normally distributed data was done using Independent Samples T-Test, while comparison between variables that did not follow the normal distribution was done using Mann Whitney U Test. Intake of food items was converted to daily portions such as that subjects who consumed an item for 3 times/day scored 3, 5 times/week (5/7= 0.714), or 15 times/ month (15/30= 0.5).

3. RESULTS

The mean age of the study sample was 44.87± 11.6 years, with no statistically significant difference between cases with NAFLD and those without (P =0.678). There were 12 (28.6%) males with normal liver ultrasound compared to 21(45.7%) males with NAFLD with no significant difference (P= 0.100). there were only two (4.8%) subjects from rural areas with normal liver, compared to 7(15.2%) with NAFLD. There was a statistically significant association between educational level and NAFLD, as 24(52.2%) patients with NAFLD had lower educational level compared to 10 (23.8%) without NAFLD. Patients with NAFLD had significantly higher percent of smokers (23.9%) compared to subjects with normal liver (4.8%), however, this could be due to sampling bias. There was no statistically significant difference in distribution of physical activity levels, as shown in Table (1).

Table 1 Basic characteristics of the study sample

Variables	NAFLD		Total	P-value
	No	Yes		
Age (Mean± SD) in years	44.33± 10.99	45.37± 12.23	44.87± 11.6	0.678*
Gender	No. (%)	No. (%)	No. (%)	-
Male	12(28.6)	21(45.7)	31(35.2)	0.100**
Female	30(71.4)	25(54.3)	57(64.8)	
Residency				
Urban	40(95.2)	39(84.8)	79(89.8)	0.161**
Rural	2(4.8)	7(15.2)	9(10.2)	
Education				
Lower than high school	10(23.8)	24(52.2)	34(38.6)	0.003**
Finished high school	3(7.1)	7(15.2)	10(11.4)	
Higher than high school	29(69)	15(32.6)	44(50)	
Smoking				
Never	38(90.5)	33(71.7)	71(80.7)	0.027**
Former	2(4.8)	2(4.3)	4(4.5)	
Current (>1 cigarette /day)	2(4.8)	11(23.9)	13(14.8)	
Physical activity				
No physical activity	35(83.3)	37(80.4)	72(81.8)	0.755**
Moderate physical activity	6(14.3)	6(13)	12(13.6)	
Active	1(2.4)	3(6.5)	4(4.5)	
Total	42(100)	46(100)	88(100)	-

*: Independent Samples T-test, **: Chi-Square test

According to abdominal ultrasound results, from 88 studied patients 46(52.2%) were having NAFLD, divided as follows: 26 (29.5%) patients had mild NAFLD, 19(21.6%) patients had moderate NAFLD and only one patient (1.1%) had severe NAFLD, and there were 42 (47.7%) normal subjects, as shown in Figure (2).

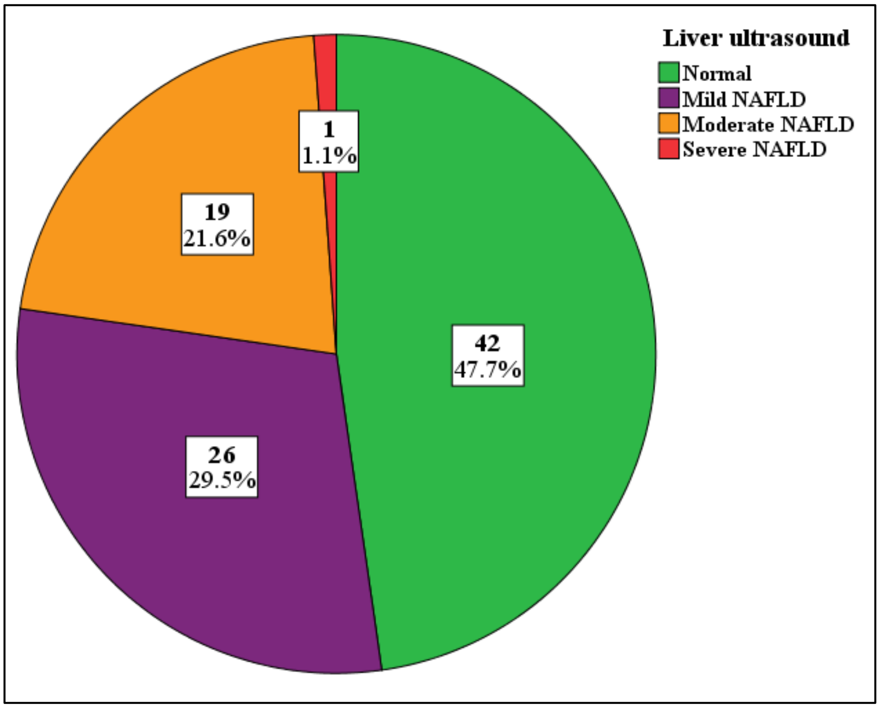

Figure 2 Severity of NAFLD of the study sample

Anthropometric measures differences showed that height was not significantly different between cases with NAFLD versus subjects without this disease, however, body weight, BMI and waist circumference were significantly higher among cases with NAFLD (Table 2).

Table 2 Distribution of anthropometric measures according to NAFLD

Variables	NAFLD		P-value
	No	Yes	
	Mean± SD	Mean± SD	
Height	163.95±9.2	166.54±11.9	0.255
Weight	82.81±13.9	93.4±17.8	0.003
BMI	30.94±5.1	33.76±6.9	0.033
Waist circumference	100.71±12	110.46±12.4	<0.001

Independent Samples T-test

All blood investigations that included (RBS, total cholesterol, s. triglyceride, HDL, LDL, s. uric acid, ALT, AST and ALP) showed no significant differences in mean values between cases with NAFLD and control group. Though, it was noticed that patients with NAFLD had elevated mean S. Triglyceride level (171.83± 82.4 mg/dl), and elevated ALT, AST, and ALP, but found of no statistical significance, as shown in Table (3).

Table 3 Distribution of blood investigations according to NAFLD

Variables	NAFLD		P-value
	No	Yes	
	Mean± SD	Mean± SD	
RBS	98±14.7	102.32±23.8	0.969
Total Cholesterol	182.8±14.8	168.94±44.2	0.328
S. Triglyceride	147±59.5	171.83±82.4	0.682
HDL	39.88±9	46.03±20.2	0.448
LDL	106.86±17.2	89.56±41.7	0.257
Uric Acid	5.33±1.2	5.22±0.8	0.861

ALT	24.96±11.2	39.98±32.1	0.166
AST	13.17±0	33.17±28.2	0.565
ALP	80.75±21	103.84±73.6	0.565

Mann Whitney U Test

There was no significant difference in daily portions of most traditional food items in comparison between patients with NAFLD and normal subjects, except for statistically significant higher rates of daily consumption of corn oil and soft drinks, as show in Table (4).

Table 4 Daily portions distribution of traditional food items according to NAFLD

Food items	Daily portions (times/ day)		P-value
	No NAFLD	NAFLD	
	Median (Min- Max)	Median (Min- Max)	
Rice	0.68(0-2)	0.75(0-2)	.480
Whole grains	0.95(0-3)	1.22(0-8)	.584
Refined grains	1.16(0-4)	1.36(0-4)	.577
Legumes	0.21(0-1)	0.22(0-1)	.584
Vegetables	1.82(0.3-3)	1.72(0.4-3)	.574
Fruits	1.34(0-4)	1.44(0-5)	.976
Eggs	0.69(0.1-2)	0.59(0-2)	.246
Dairy products	0.79(0-2)	0.75(0-3)	.528
Red meat	0.46(0-2)	0.55(0-2)	.636
Chicken	0.48(0-2)	0.54(0-3)	.693
Fish	0.17(0-1)	0.19(0-0.6)	.292
Nuts	0.43(0-2)	0.38(0-1)	.839
Seeds	0.3(0-1)	0.32(0-1)	.932
Olive oil	0.31(0-1)	0.28(0-2)	.666
Corn oil	0.29(0-2)	0.7(0-2)	.027
Sunflower	2.14(0-3)	1.7(0-3)	.149
Tea	2.33(0-6)	2.52(0-10)	.976
Pickles	0.42(0-2)	0.57(0-3)	.344
Soft drinks	0.22(0-1)	0.49(0-3)	.023
Coffee	0.32(0-3)	0.37(0-4)	.216
Fast food	0.2(0-1)	0.39(0-3)	.162
Cakes and snacks	0.55(0-2)	0.65(0-4)	.507

Mann Whitney U Test

There was no significant difference in daily portions of most western food items in comparison between patients with NAFLD and normal subjects, except for statistically significant higher rates of daily consumption of processed meat, pasta and soft drinks, as show in Table (5).

Table 5 Daily portions distribution of western food items according to NAFLD

Food items	Daily portions (times/ day)		P-value
	No NAFLD	NAFLD	
	Median (Min- Max)	Median (Min- Max)	
Red meat	0.46(0-2)	0.55(0-2)	.636
Processed meats	0.02(0-0.3)	0.04(0-0.1)	.03

Chicken	0.48(0-2)	0.54(0-3)	.693
Fish	0.17(0-1)	0.19(0-0.6)	.292
Dairy products	0.79(0-2)	0.75(0-3)	.528
Refined grains	1.16(0-4)	1.36(0-4)	.577
Pasta	0.04(0-0.6)	0.09(0-1)	.010
Fast food	0.2(0-1)	0.39(0-3)	.162
Soft drinks	0.22(0-1)	0.49(0-3)	.023
Cakes and snacks	0.55(0-2)	0.65(0-4)	.507
Sugar	2.26(0-6)	2.92(0-10)	.060
Nuts	0.43(0-2)	0.38(0-1)	.839

Mann Whitney U Test

The risk stratification for NAFLD revealed that the food pattern those patients with NAFLD were more likely to practice western food pattern by 3.52 times, while other food patterns had no statistically significant influence on NAFLD. As shown in Table (6).

Table 6 Risk for developing NAFLD according to dietary patterns

Variables	Mean odd's ratio	95% CI	P-value
Traditional	1.86	0.67- 5.02	0.221
Western	3.52	1.23- 10.07	0.019

Binary Logistic Regression

4. DISCUSSION

In the current study two dietary patterns were considered: traditional pattern, and western pattern. The traditional Iraqi meals include the following: rice, refined grains, whole grains, legumes, fruits, vegetables, eggs, dairy products, red meat, chicken, fish, nuts, seeds, sunflower oil, corn oil and olive oil, pickles, cakes and snacks, fast food, soft drinks, tea and coffee.While the western food pattern considered when high consumption of: refined grains, red meat, processed meats, chicken, fish, dairy products, pasta, fast foods, soft drinks, cakes and snacks, nuts and sugar. It has been found in the current study that the western diet patterns were significantly associated with a higher risk for NAFLD. This association was independent of age, gender, residency and physical activity. A previous study by (Salehi-sahlabadi et al., 2021) supported this study, as well as (Fakhoury-Sayegh et al., 2017). While (Chung et al., 2019) disagree with this study, as they found that the traditional Korean diet is the culprit.

The current study revealed that the western diet patterns showed statistically significant higher consumption of processed meats, pasta and soft drinks in patients with NAFLD than cases without the disease. A meta-analysis showed that use of red meat and soft drinks increased possibility of NAFLD (He et al., 2020). Also, consuming more red meat is related to insulin resistance (Zelber-Sagi et al., 2018). In addition, refined grain, white bread, and sugar-sweet desserts, that make a large portion of western diet patterns, causes elevation in insulin and glucose levels, contributing in metabolic syndrome (Liu et al., 2000). It has been indicated that higher carbohydrate-containing diets cause lipid to accumulate in hepatocytes and leads to liver steatosis (Valtuena et al., 2006). Soft drinks and snacks may have higher risk for NAFLD because they contain high amounts of sugars like fructose and sucrose, which have been linked to the pathophysiology of NAFLD; one study suggested that NAFLD could be caused by fructose's potential role in liver de novo lipogenesis and hepatic inflammation (Lim et al., 2010). The Western diet is generally expressed as being high in total energy with a high component of saturated fat, trans-fatty acids and refined sugars.

This study did not show a significant association between the Iraqi traditional dietary pattern (IDT) and NAFLD. The diverse components of the "ITD" may be to blame for the lack of significant associations. The "ITD" contains healthy food items that may have a protective effect against the development of NAFLD, however ITD also contain unhealthy food items that may enhance the risk of NAFLD.As the "ITD" consist of several food items like red meat, fast food, refined grains, soft drinks, cakes, snacks and pickles or salty foods (Shen et al., 2019), which have been described to be risk factors for NAFLD; nevertheless, there are as well other food items that have anti-inflammatory and anti-oxidative functions. Curcumin, cinnamon, cardamom, black pepper, cloves, ginger, garlic and onion powders which are the most common seasonings used in the Iraqi cuisine have possibly a protective sequel on the liver (Hajimonfarednejad et al., 2019; Mansour-Ghanaei et al., 2019; Sahebkar, 2011).

In this study the mean for weight in NAFLD cases was significantly higher than the control group (p=0.003), also the BMI (p=0.033), and the p value for the waist circumference was (<0.001), this goes with (Fakhoury-Sayegh et al., 2017), while (Salehi-sahlabadi et al., 2021) showed no significant association with the waist circumference but there were significant association in weight and BMI. This finding in patients with NAFLD, as the increase in waist circumference implies an accumulation of intra-abdominal adipose tissue that can lead to metabolic syndrome and liver steatosis (Dowman et al., 2010). Insulin resistance in NAFLD is linked to waist circumference rather than BMI, and fatty liver is one of the manifestations of metabolic syndrome (Mouzaki and Allard, 2012).

In this study there was no difference considering the physical activity between the two groups, this finding disagrees with (Fakhoury-Sayegh et al., 2017) and (Salehi-sahlabadi et al., 2021). We attribute the reason that most Iraqis do not exercise, so we didn’t see a difference between the two groups. A review by (Mouzaki and Allard, 2012) showed that vigorous physical activity was associated with decreased risk of developing NAFLD. There was a significant association between NAFLD and smoking, as smoking has long been recognized as a source of oxidative stress, this finding is supported (Chung et al., 2019; Fakhoury-Sayegh et al., 2017; Salehi-sahlabadi et al., 2021). A significant difference regarding the level of education was found between cases and controls (p=0.003), the same finding in (Fakhoury-Sayegh et al., 2017; Salehi-sahlabadi et al., 2021), this might be explained by the higher awareness about healthy food choices.

5. CONCLUSION

The current study has found that the western diet patterns in particular processed meat, pasta and soft drinks were associated with an increased risk of NAFLD in Iraqi adults. This can be used to reduce the onset and progression of NAFLD.

Author contribution

Nawal Mehdi Al Khalidi: Conception and design of the work, the acquisition, analysis, and interpretation of data for the work, and Drafting the work.; Zainab Ghanim Kadhim: Conception and design of the work, interpretation of data for the work, and revising it critically for important intellectual content; Hayat Yahya Almousawi: Conception and design of the work, interpretation of data for the work, and revising it critically for important intellectual content

Informed consent

Written informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards (Code: 2019/C081).

Conflicts of interest

The authors declare that they have no conflict of interest.

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Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

1. Adriano LS, de Carvalho Sampaio HA, Arruda SPM, de Melo Portela CL, de Melo MLP, Carioca AAF, Soares NT. Healthy dietary pattern is inversely associated with non-alcoholic fatty liver disease in elderly. Br J Nutr 2016; 115(12):2189-95.
2. Bedogni G, Nobili V, Tiribelli C. Epidemiology of fatty liver: an update. World J Gastroenterol 2014; 20(27):9050.
3. Bellentani S. The epidemiology of non-alcoholic fatty liver disease. Liver international 2017; 37:81-4.

4. Cheung O, Sanyal AJ. Recent advances in nonalcoholic fatty liver disease. Curr Opin Gastroenterol 2010; 26(3):202-8.
5. Chung GE, Youn J, Kim YS, Lee JE, Yang SY, Lim JH, Song JH, Doo EY, Kim JS. Dietary patterns are associated with the prevalence of nonalcoholic fatty liver disease in Korean adults. Nutrition 2019; 62:32-8.
6. Cordero P, Li J, Oben J. Obesity and NAFLD. In: Sbraccia P, Finer N, editors. Obesity: Pathogenesis, Diagnosis, and Treatment. Cham, Switzerland: Springer International Publishing; 2019. p. 179- 94.
7. Dowman JK, Tomlinson JW, Newsome PN. Pathogenesis of non-alcoholic fatty liver disease. QJM: Int J Med 2010; 103(2):71-83.
8. Fakhoury-Sayegh N, Younes H, Heraoui GNHA, Sayegh R. Nutritional profile and dietary patterns of lebanese non-alcoholic fatty liver disease patients: a case-control study. Nutrients 2017; 9(11):1245.
9. Ferraioli G, Soares Monteiro LB. Ultrasound-based techniques for the diagnosis of liver steatosis. World J Gastroenterol 2019; 25(40):6053-62.
10. Ganguli D, Das N, Saha I, Biswas P, Datta S, Mukhopadhyay B, Chaudhuri D, Ghosh S, Dey S. Major dietary patterns and their associations with cardiovascular risk factors among women in West Bengal, India. Br J Nutr 2011; 105(10):1520-9.
11. Hajimonfarednejad M, Ostovar M, Raee MJ, Hashempur MH, Mayer JG, Heydari M. Cinnamon: A systematic review of adverse events. Clin Nutr 2019; 38(2):594-602.
12. He K, Li Y, Guo X, Zhong L, Tang S. Food groups and the likelihood of non-alcoholic fatty liver disease: A systematic review and meta-analysis. Br J Nutr 2020; 124(1):1-13.
13. Lim JS, Mietus-Snyder M, Valente A, Schwarz J-M, Lustig RH. The role of fructose in the pathogenesis of NAFLD and the metabolic syndrome. Nat Rev Gastroenterol Hepatol 2010; 7(5):251-64.
14. Liu S, Willett WC, Stampfer MJ, Hu FB, Franz M, Sampson L, Hennekens CH, Manson JE. A prospective study of dietary glycemic load, carbohydrate intake, and risk of coronary heart disease in US women. Am J Clin Nutr 2000; 71(6):1455-61.
15. Mansour-Ghanaei F, Pourmasoumi M, Hadi A, Joukar F. Efficacy of curcumin/turmeric on liver enzymes in patients with non-alcoholic fatty liver disease: a systematic review of randomized controlled trials. Integr Med Res 2019; 8(1):57-61.
16. Marchesini G, Brizi M, Bianchi G, Tomassetti S, Bugianesi E, Lenzi M, McCullough AJ, Natale S, Forlani G, Melchionda N. Nonalcoholic fatty liver disease: a feature of the metabolic syndrome. Diabetes 2001; 50(8):1844-50.
17. Marchesini G, Brizi M, Morselli-Labate AM, Bianchi G, Bugianesi E, McCullough AJ, Forlani G, Melchionda N. Association of nonalcoholic fatty liver disease with insulin resistance. Am J Med 1999; 107(5):450-5.
18. Marchesini G, Petta S, Dalle Grave R. Diet, weight loss, and liver health in nonalcoholic fatty liver disease: Pathophysiology, evidence, and practice. Hepatology 2016; 63(6):2032-43.
19. Mouzaki M, Allard JP. The role of nutrients in the development, progression, and treatment of nonalcoholic fatty liver disease. J Clin Gastroenterol 2012; 46(6):457-67.
20. Orci LA, Gariani K, Oldani G, Delaune V, Morel P, Toso C. Exercise-based interventions for nonalcoholic fatty liver disease: a meta-analysis and meta-regression. Clin Gastroenterol Hepatol 2016; 14(10):1398-411.
21. Sahebkar A. Potential efficacy of ginger as a natural supplement for nonalcoholic fatty liver disease. World J Gastroenterol 2011; 17(2):271.
22. Salehi-sahlabadi A, Sadat S, Beigrezaei S, Pourmasomi M, Feizi A, Ghiasvand R, Hadi A, Clark CCT, Miraghajani M. Dietary patterns and risk of non-alcoholic fatty liver disease. BMC Gastroenterol 2021; 21(1):41.
23. Sayadishahraki M, Hekmatnia A, Hekmatnia F, Kouhi H, Soleimany S, Soufi GJ. How is the impact of bariatric surgery on ultra-sonographic findings of non-alcoholic fatty liver disease among morbidly obese patients?. Medical Science, 2020;24(103):1586-1591
24. Schulz PO, Ferreira FG, Nascimento MdFA, Vieira A, Ribeiro MA, David AI, Szutan LA. Association of nonalcoholic fatty liver disease and liver cancer. World J Gastroenterol 2015; 21(3):913.
25. Shen X, Jin C, Wu Y, Zhang Y, Wang X, Huang W, Li J, Wu S, Gao X. Prospective study of perceived dietary salt intake and the risk of non-alcoholic fatty liver disease. J Hum Nutr Diet 2019; 32(6):802-9.
26. Smith BW, Adams LA. Non-alcoholic fatty liver disease. Crit Rev Clin Lab Sci 2011; 48(3):97-113.
27. Thomas JA, Acharya S, Shukla S, Thomas JJ, Pratapa SK, Hulkoti V. Non Alcoholic Fatty Liver Disease (NAFLD) in Metabolic Syndrome (MetS)- A case control study. Medical Science, 2020;24(103):1490-1499
Tucker KL. Dietary patterns, approaches, and multicultural perspective. Appl Physiol Nutr Metab 2010; 35(2):211-8.
28. Valtuena S, Pellegrini N, Ardigo D, Del Rio D, Numeroso F, Scazzina F, Monti L, Zavaroni I, Brighenti F. Dietary glycemic index and liver steatosis. Am J Clin Nutr 2006; 84(1):136-42.
29. Vernon G, Baranova A, Younossi ZM. Systematic review: the epidemiology and natural history of non-alcoholic fatty liver disease and non-alcoholic steatohepatitis in adults. Aliment Pharmacol Ther 2011; 34(3):274-85.
30. Younossi ZM, Koenig AB, Abdelatif D, Fazel Y, Henry L, Wymer M. Global epidemiology of nonalcoholic fatty liver

disease—meta-analytic assessment of prevalence, incidence, and outcomes. Hepatology 2016; 64(1):73-84.

31. Zelber-Sagi S, Ivancovsky-Wajcman D, Isakov NF, Webb M, Orenstein D, Shibolet O, Kariv R. High red and processed meat consumption is associated with non-alcoholic fatty liver disease and insulin resistance. J Hepatol 2018; 68(6):1239-46.
32. Zoppini G, Fedeli U, Gennaro N, Saugo M, Targher G, Bonora E. Mortality from chronic liver diseases in diabetes. Am J Gastroenterol 2014; 109(7):1020-5.